Renewable Energies

Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability	**Education cycle** 2025/26
Speciality Sustainable Physics & Chemistry	**Subject code** UJ.WPAJBSSPCS.8100.16412.25
Organizational unit Faculty of Law and Administration	**Lecture languages** english
Study level first cycle (joint degree programme)	**Subject related to scientific research** Yes
Study form full-time degree programme	**Disciplines** Physical sciences
Education profile General academic	**ISCED classification** 0713 Electricity and energy
Mandatory obligatory	**USOS code**

Subject coordinator	Piotr Szwedo
Lecturer	Fatima Martin Hernandez, Loreto Garcia Fernandez, Jorge Contreras, Juan Jose Ledo, Ana Negredo, Luis Duran, Timo Leskinen, Markku Kulmala

Period	**Examination**	**Number of ECTS points**
Semester 5	exam **Activities and hours** Discussion class: 45	5.0

Goals

C1	The course introduces students to the main renewable energy technologies. It covers the physical principles behind renewable energy technologies in addition to their mechanisms and effectiveness. The course covers wind, solar, geothermal, biomass, and hydropower-based energy technologies in terms of their concept, energy conversion systems, and design principles of their large-scale application. In addition, the course introduces the principles of energy storage, conversion, and efficiency as well as Risk analysis of renewable energy systems.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the main renewable energy resources available at the moment and the physical principles behind them	JBS_K1_W01, JBS_K1_W06, JBS_K1_W07	written exam
W2	the mechanism and effectiveness of the main renewable energy technologies	JBS_K1_W01, JBS_K1_W05, JBS_K1_W07	written exam
Skills – Student can:			
U1	calculate economical productivity of each renewable energy resource	JBS_K1_U02, JBS_K1_U03, JBS_K1_U04	written exam
U2	evaluate whether a source of energy can or cannot be considered renewable	JBS_K1_U02, JBS_K1_U03, JBS_K1_U04	written exam
Social competences – Student is ready for:			
K1	to provide the society with scientific arguments to improve a transition into clean energies in our society	JBS_K1_K01	written exam
K2	to assist decision-makers with scientific arguments to defend policies helping the transition into a sustainable energy model	JBS_K1_K05	written exam

Calculation of ECTS points

Activity form	Activity hours*	
Discussion class	45	
preparation for classes	32	
exercises performance	10	
tasks solving	5	
preparation for the exam	48	
Student workload	**Hours** 140	**ECTS** 5.0

* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Introductory concepts: Energy, climate and society, Natural resources and evaluation techniques	W1, W2, U2
2.	Main renewable energies. Present and future of renewable energy	W1, W2, U2

No.	Course content	Subject's learning outcomes
3.	Wind basics	W1, W2
4.	Wind resource assessment	W1, W2, U1
5.	Wind energy conversion systems	W1, W2, U1
6.	Design principles of electrical wind farm	W1, W2, U1
7.	Exercise session: Essay on the degree of implementation of wind power plant in a specific region of the world and its potentiality	W1, W2, U1
8.	Other sources. Bioenergy, Biomass and biofuels, Marine Energy, etc	W1, W2
9.	Solar resource assessment	W1, W2, U1
10.	Solar energy conversion systems: thermal	W1, W2, U1
11.	Photovoltaic cell fundamentals, Photovoltaic modules, Photovoltaic energy conversion, Basic design of a photovoltaic system.	W1, W2, U1
12.	Design principles of a solar farm	W1, W2, U1
13.	Exercise session: Analysis and discussion of an actual photovoltaic project	W1, W2, U1
14.	Geothermal resource assessment	W1, W2, U1
15.	Geothermal power generation technologies	W1, W2
16.	Geothermal heat pumps and direct-use applications	W1, W2
17.	Design principles of thermal energy exploration and reservoir engineering	W1, W2
18.	Hydropower resource assessment, Hydropower energy conversion systems	W1, W2, U1
19.	Exercise session: Analysis of the environmental impact and economical viability of a geothermal project in a region of environmental interest	U1
20.	Design principles of hydropower plant	W1, W2, U1
21.	Energy storage, conversion, and efficiency	W1, W2
22.	Risk analysis of renewable energy systems	U1, U2
23.	Exercise session: Economic and geopolitical analysis of the massive implementation of renewable energies in a specific country.	U1
24.	Exercise session: Selection of the most appropriate renewable technology based on the natural resources available at the point of study	K1, K2

Course advanced

Teaching methods :

conversation lecture, solving tasks, practicals

Activities	Examination methods	Credit conditions
Discussion class	written exam	Final exam counts 60% of the final grade. Maximum of 3 bonus points can be gathered for the exam. Bonus points are based on the number of completed exercises.

Entry requirements

None

Literature

Obligatory

1. Renewable Energy Resources. John Twidell and Anthony D. Weir. Ed. Taylor & Francis Environmental Physics: Sustainable Energy and Climate Change. Egbert Boeker and Rienk van Grondelle. Ed. John Wiley and Sons, 3rd ed.

Effects

Code	Content
JBS_K1_K01	The graduate can encourage sustainability-driven practices in the workplace and appraise sustainability of own values, perceptions, roles, and actions, with a special focus on environmental wellbeing.
JBS_K1_K05	The graduate can defend the importance of scientific data and methods as a basis for decision-making.
JBS_K1_U02	The graduate can present and report knowledge, methodologies, ideas, problems and solutions, clearly and comprehensively, in different forms destined for different audiences – including discussions and debates which require defending a substantiated opinion, as well as conversations in a foreign language at the CEFR B2 level.
JBS_K1_U03	The graduate can apply adequate methods and tools, including selected IT tools, to solve problems related to data collection, analysis, and management in the context of sustainability.
JBS_K1_U04	The graduate can plan and effectuate simple sustainability-related projects under supervision and in the context of personal lifelong learning, both individually and in a team, using appropriate transversal skills and taking shared responsibility for the outcome.
JBS_K1_W01	The graduate can describe the concept of sustainability and recognize the differences in relevant definitions, models and approaches.
JBS_K1_W05	The graduate can identify essential international instruments and institutions related to sustainability and explain their potential role in resolution of a given problem.
JBS_K1_W06	The graduate can describe interconnections between various aspects of sustainability and identify their significance in the context of natural and social sciences, with a special focus on disciplines included in the selected specialisation track (law and politics; chemistry and physics; chemistry and biology; economics and geography; economics, management and engineering; humanities).
JBS_K1_W07	The graduate can apply the theory and methodology of disciplines included in the selected specialisation track to sustainability-related problems, taking into consideration practical limitations such as protection of intellectual property.